# CHEMICAL FORECASTING AND NEAR-REAL-TIME CTM ANALYSIS IN SUPPORT OF INTEX-A

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We will support the deployment of INTEX-A through two activities: (1) providing twice-daily chemical forecasts over the course of the mission, based on GEOS-4 meteorological forecasts by the NASA Global Modeling and Assimilation Office (GMAO); (2) conducting near-real-time CTM analyses with the GEOS-CHEM global model of oxidant-aerosol chemistry and greenhouse gases, driven by first-look assimilated GEOS-4 data generated as the mission progresses. In addition, Jacob will serve as deputy mission scientist for INTEX-A with specific responsibility for leading the INTEX-A theoretical team in day-to-day flight planning.

We will produce twice-daily, 5-day chemical tracer forecasts using the GEOS-4 general circulation model (GCM) initialized with assimilated meteorological data. The forecasts will be conducted at GMAO in parallel to the operational GEOS-4 meteorological forecasts. The resolution will be 1.25°×1° (longitude by latitude) with 55 vertical levels. The GEOS-4 GCM will be run in two modes: (i) an ongoing simulation constrained by GEOS-4 meteorological analyses; (ii) five-day forecasts, initialized twice each day (at 00 and 12GMT), starting from the state produced by run (i). Eleven chemical tracers will be included in the forecasts:

- Total CO and five tagged CO tracers originating from North American anthropogenic emissions, biomass fires, Mexico, Europe, and Asia;
- Ozone produced in the stratosphere and in the troposphere;
- Sulfate aerosol;
- Methane;
- Carbon dioxide.

We will also include puff releases of additional CO tracers over the course of the mission to forecast the transport of plumes from large North American or Eurasian fires detected by MODIS, and to support Lagrangian studies of trans-Atlantic transport in collaboration with our ICARTT partners.

All tracers will use a linear formulation of sources and sinks to allow expedient computation within the GCM. This linearization will use archived monthly 3-D fields of OH concentrations, ozone and sulfate production rates, and ozone loss frequencies from a previous-year (2001) simulation with the GEOS-CHEM model. Sources of CO and $CO_2$ will be taken from the GEOS-CHEM model. Sulfate aerosol will be removed by wet deposition as determined from the GEOS-4 hydrological cycle.

Visualization and dissemination of the chemical forecasts will be done with a web-site module on a dedicated linux server at U. Washington. The web interactive interface will allow members of the ICARTT Science Team to produce custom maps, vertical profiles, animations, and time series from the forecast output. In addition we will implement curtain plot generation, customized to aircraft flight plans (users will enter coordinates of the flight plan to generate forecasts). After each flight we will update the site with direct comparisons between model forecasts and observations.

We will also carry out a detailed ozone-aerosol-CO-$CO_2$-methane GEOS-CHEM simulation with $1^o$x$1.25^o$ horizontal resolution in near-real-time over the course of the mission, using the first-look GEOS-4 assimilated meteorological data generated by GMAO. This simulation will lag the observations by only 2-3 days. It will have three purposes: (1) monitor over the course of the mission any large deviations between the aircraft observations and our understanding of ozone and aerosol processes that may cause alteration of flight plans; (2) generate, by the end of the INTEX-A mission, a set of preliminary findings from the mission.

The simulation will include our most detailed GEOS-CHEM representation of coupled nonlinear ozone-$NO_x$-VOC-aerosol chemistry. Anthropogenic emissions in the United States will be from the NEI 1999 inventory. Fires in North America and northern Asia will be included in the simulation on the basis of MODIS satellite observations. Model results and comparisons to field observations will be posted continuously on a web site accessible by the ICARTT Science Team.

Results from this project will make a major contribution to the success of INTEX-A. This contribution will be on three levels:

**(1) Collection of an optimal data set.** The success of INTEX-A will ride on its ability to deliver observations that advance significantly our quantitative understanding of emissions in North America, the processing of these emissions in the continental boundary layer, the outflow from the boundary layer, and the subsequent evolution. Our work in chemical forecasting and day-to-day flight planning will focus on optimizing the information content of the INTEX-A data. This optimization will take into account the availability of complementary data sets from the other ICARTT aircraft, from satellites (MOPITT, MODIS, SCIAMACHY), and from surface sites.

**(2) Delivery of quick-look analyses for preliminary assessment of mission findings.** The INTEX-A mission will return a rich data set, whose analysis will involve years of productive work. However, it is also important that we be able to deliver reports of preliminary findings during and very shortly after the mission. Our detailed GEOS-CHEM simulations conducted in near-real-time using quick-look assimilated meteorological data will allow us to make preliminary assessments of INTEX-A results in relation to mission objectives.

**(3) Coordination with other ICARTT activities.** Coordination of the ICARTT aircraft during mission deployment will be essential for the collective data set to be greater than the sum of its parts. Our group is already involved in the NOAA ITCT-2K4 mission and will have a representative (graduate student Rynda Hudman) in permanence with the NOAA aircraft in Portsmouth. We also have established collaborations and contacts with other ICARTT components, and Jacob is on the steering committee for designing the ICARTT Lagrangian trans-Atlantic transport experiment. We will work to ensure that the execution of the INTEX-A mission is well integrated within the broader ICARTT context.